PHASE 1 REPORT

INFILTRATION & INFLOW STUDY
TOWN OF CENTREVILLE

Prepared for:
Town of Centreville
Centreville, MD

April 2005

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I. INTRODUCTION:

The Town of Centreville is located on Route 213 in the center of Queen Anne's County, MD. The Town was established in 1794 and is situated on the Chesapeake Bay. The current population of Centreville exceeds 2,300 people. The Town is the County Seat and is made up of Government and other office buildings, stores, older residential communities and new business parks and residential communities being constructed on the outskirts of Town.

The Town provides wastewater collection and treatment to all residents, offices and businesses in Centreville. An expansion to the Wastewater Treatment Plant (WWTP) has just been completed. The collection and conveyance systems continue to expand in response to local development.

The Centreville WWTP has been receiving wastewater flows that increase substantially during wet seasons and rain events. This situation is indicative of extraneous water entering the sewer system in the form of *inflow and infiltration* (I&I).

Infiltration is the amount of extraneous flow entering the sanitary sewer collection system from the ground through defective joints in piping, defective pipe, defective seals in manholes, defective lateral connections, etc. The amount of leakage is typically related to the depth of the pipe beneath the groundwater table. Poor piping above the groundwater table generally will not exhibit signs of steady infiltration; however, *Rain Induced Infiltration (RII)* will be apparent during periods of extremely saturated soils as a result of continuous heavy rains. Infiltration occurs when existing sewer pipes and manholes deteriorate and when new piping is constructed poorly.

Inflow is defined as extraneous flow discharged into a sanitary sewer collection system. Inflow sources typically include sump pump connections, house downspout connections to the sewer, cross connections with storm sewers, faulty manhole lids, faulty clean out caps in yards, yard drains, street run off, etc. Inflow generally occurs from direct non-sanitary connections to the sewer piping.

Extraneous water from I&I sources into a sanitary sewer collection system reduces capacity and can present public health hazards if sewage overflows occur. A collection system can become hydraulically overloaded and the elimination of these extraneous flows can reduce the risk of health hazards, reduce the costs of collection and treatment, and can provide additional available capacity to the system. A logical and systematic approach is necessary to determine the severity of the problem and to locate the sources of I&I.

The purpose of the study is to determine if there is an I&I problem in the Town of Centreville and to identify, in a general manner, the sources of extraneous flow into the Town's collection system of pipes.

II. BACKGROUND:

The age of the collection system is varied. The WWTP was originally upgraded in the late 1950's, however URS has been unable to determine when the WWTP was initially constructed. It is possible some of the older collection system in Town was constructed long before the WWTP expansion in the 1950's and could have been built in the 1930's or 1940's.

The piping in the study area is predominantly Vitrified Clay Pipe (VCP) with some Ductile Iron Pipe (DIP) and Plastic (PVC) pipe. The study area is shown on Figure 1 and does not include the newer construction around the outskirts of own.

VCP pipes are composed of crushed and blended clay that are formed into pipes, then dried and fired in a succession of temperatures. The final firing gives the pipes a glassy finish. Prior to the 1970's vitrified clay pipes have been used for hundreds of years and were considered strong, resistant to chemical corrosion, internal abrasion, and external chemical attack. The major disadvantages to VCP pipe are that the pipe is produced in short lengths that create numerous joints coupled with the fact that the joints of VCP pipe typically are not sealed or are sealed poorly with mortar, lead or bituminous coatings creating multiple opportunities for infiltration.

The manholes in the study area are constructed of brick or precast concrete with a variety of manhole frames and covers.

III. METHODOLOGIES:

As stated previously, a logical and systematic approach is necessary to determine the severity of the problem and to locate the sources of I&I. URS proposed to perform the following preliminary tasks to identify sources of extraneous flow into the Town of Centreville's collection system.

1. Review all existing data relating to previous studies, water consumption, flow records, mapping, etc.

2. Review the existing plans of the collection system and separate the piping into sub-basins to facilitate the study. Number the collection system manholes and prepare a base map.

3. Perform surface inspections of the collection system to locate obvious sources of extraneous flow. Initial field work consists of a preliminary surface inspection of the collection system. The surface inspection of the system is typically performed during wet weather to determine if the manhole lids are a source of extraneous flow. In addition, the surface inspection allows for verification of existing collection system mapping, allows for the identification of "Hot Spots" where large flows may enter in small areas such as stream crossings, and could provide information as to the source of extraneous flows such as the observation of broken clean out covers, down spout connections, and sink holes over the sewer pipe. The inspection includes the removal of selected manhole covers and is a quick indication of the collection system condition. At this time the flow monitoring points (manholes) for each drainage basin are reviewed and analyzed. The observations are recorded on an inspection report and sources of extraneous flow shown on the base map of the collection system.

4. Perform an inspection of the North and South pump station wet wells to eliminate the structures as sources of extraneous flow.

5. Conduct weir testing of the sanitary sewer. Weir testing is a manual flow measurement method that involves the use of a portable compound weir. The weir incorporates the advantage of a 90-degree V-notch for measuring small flow rates where accuracy is of prime importance and a rectangular weir for measuring larger flows. The purpose of weir testing is to assist in verifying flow meter readings along with identifying drainage basins that contribute to I&I. The weir testing is performed at night between the hours of 12:00 AM and 6:00 AM. Problem subsystems are shown on the base map and identified for possible further investigation with a Closed Circuit Television Camera (CCTV) and smoke testing. CCTV work and smoke testing are typically future (Phase II) work tasks.

   Dry Weather Weir Testing – During periods of high groundwater or when pipes are located within the water table, water can infiltrate into the collection system piping through bad pipe joints, improper lateral connections to the main piping, improper lateral piping / plumbing, etc. This *infiltration* can be measured by taking flow measurements in the piping when the system is not in use and when there is no rain or run off water such as snow melt.

   Wet Weather Weir Testing - During periods of rain or runoff conditions such as snow melt, water can enter the system through cross connections with storm sewers, through manhole castings, from roof drains, sump pumps, broken clean out covers, etc. This *inflow* can be measured by taking flow measurements in the piping when the system is not in use and it is under the influence of surface water.

6. Closed Circuit TV Inspection of Piping – A closed circuit TV inspection (CCTV) of the piping will quickly reveal the condition of the piping, the location and condition of lateral connections, the location of illegal lateral connections, and other helpful information. The piping is pressure cleaned prior to the inspection. A crawler camera is placed in the pipe and the entire length of pipe between manholes is videotaped with computer logs of observations generated at the site.

   Typically, the CCTV inspection of the pipe is performed during the Phase II Study; however, limited sections of pipe were CCTV'd during this initial phase. Pipe segments were cleaned where initial weir testing revealed that the pipe sections contained too much sediment or grease to get useful measurements. It was decided to perform the CCTV investigation concurrent with the cleaning since the additional costs were minor when compared to just cleaning the pipe.

7. Prepare a report to the Town of Centreville listing the results of the investigation with recommendations for Phase II investigations to locate more precisely the sources of the I&I, to determine the nature of the leaks, and to develop recommendations to rehabilitate the system.

IV. STUDY RESULTS:

1. Review Existing Data

Flow Data – Typically, URS can complete a "flow characterization" to estimate the amount of extraneous flow entering the collection system. The flow characterization involves estimating theoretical sewage flows based on water use data and plotting this anticipated flow versus actual WWTP flow data, dry weather weir data, and weather data. URS did not complete this task in this study due to the unavailability of "sold water" data as of the writing of this report.

URS reviewed WWTP flow data measured by the new influent meter at the WWTP for the month of February, 2005. The new meter records data in high resolution 15 minute intervals. A graph has been generated to depict the typical flow patterns into the WWTP throughout the day and is displayed as Figure 1. The typical flow patterns display the diurnal influent flow characteristic throughout the day. As you will note, the system has two peak flow times each day that occur during late morning and early evening. The peak conditions correspond with heavier usage during the morning and dinner time. You will also note that during the early morning hours, the flow never approaches zero as would be anticipated in a water tight system since water use/disposal should be relatively small at that time of the day. The fact that the Town continues to see an influent flow of approximately 225,000 gpd at that time indicates a steady source of extraneous flow indicative of infiltration of groundwater. The influent flow meter records also validate the measured dry weather weir data conducted in the middle of the night that is displayed later in this report.

The influent WWTP flow meter also indicates inflow spikes during rain events. The second graph (Figure 2) illustrates two rain event periods and the resulting impact on flow into the WWTP. As you will note, there are visible increases in flow to the WWTP when compared with the typical average flow pattern at the WWTP. This is indicative of inflow and rain induced infiltration entering the collection system. The magnitude and intensity of the rain events will proportionally cause increases in extraneous sources of inflow into the WWTP.

Figure 1
Centreville WWTP
Daily Influent Flow Trends
February 2005

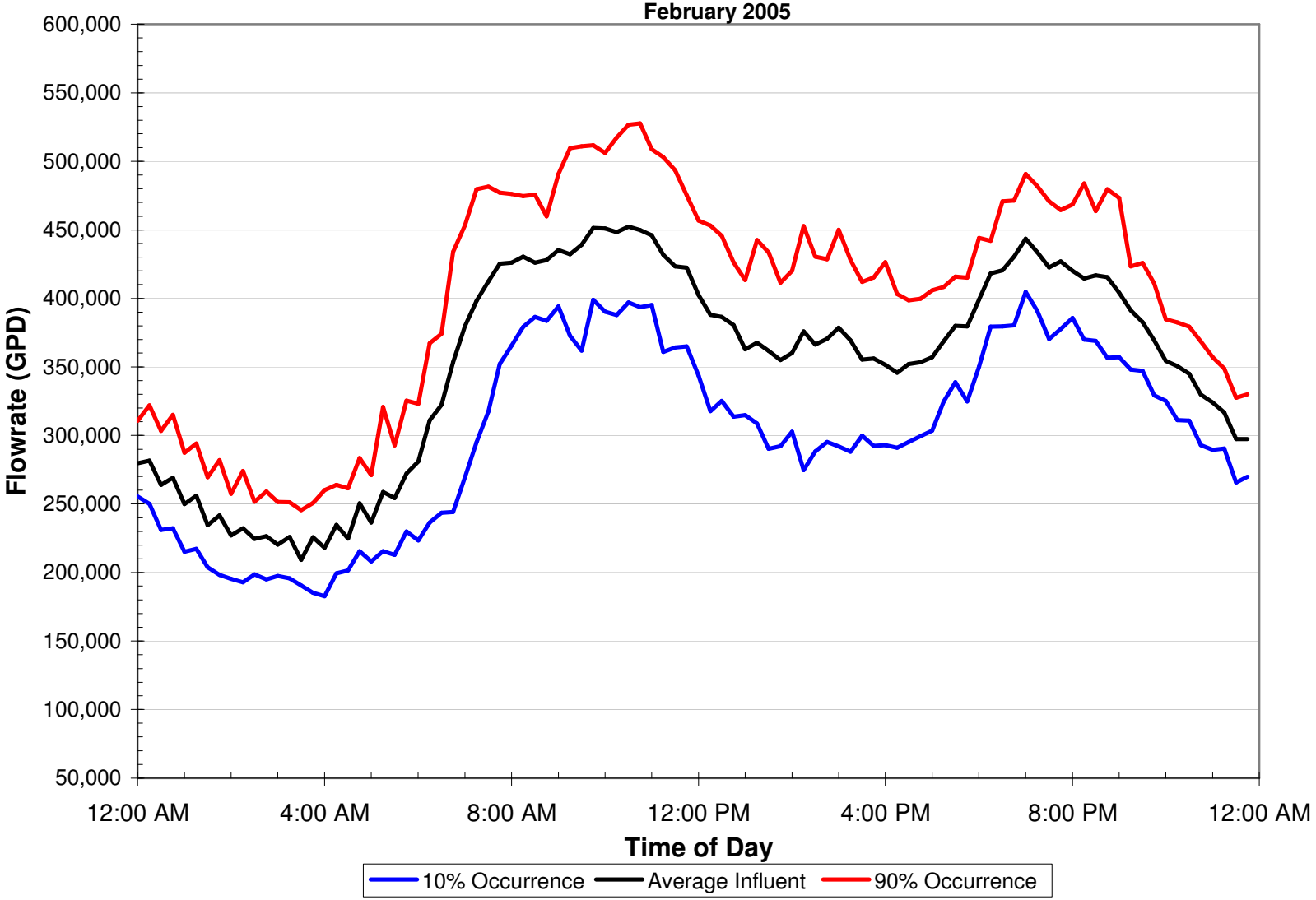
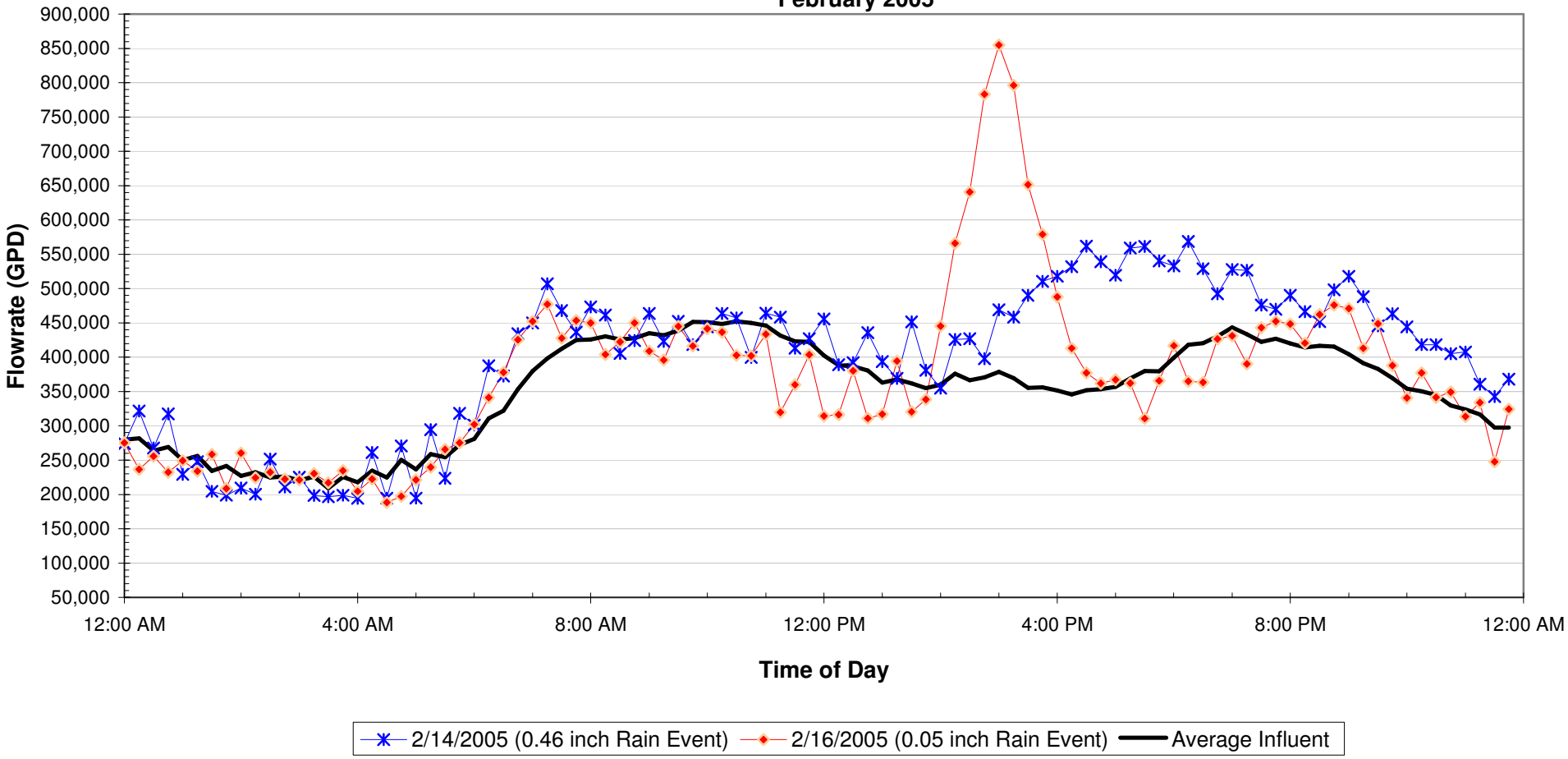


Figure 2
Centreville WWTP Influent Data (Rain Examples)
February 2005



2. Preparation of a Base Map

As part of our services to the Town, URS prepared a base map of the collection system (See Attachment). The Town provided a collection system map that appears to have been created in 1996. URS scanned the map into a digital format and imported it into a Geographical Information System (GIS) database. Local land records were also imported into the GIS database to show the layout of the Town. Distinct points in the collection system map were matched with the same points on the land records to yield a digitized system map. Updates to the 1996 map were incorporated based on a visual survey of the sanitary system.

To facilitate the data gathering and weir testing portion of the project, URS separated the collection system into seven drainage basins with smaller segments identified within each basin. URS also assigned each manhole on the map a number.

3. Surface Inspections

URS Corporation's initial field work consisted of a preliminary surface inspection of the collection system.

a. Observations Related to Manholes

Manhole Surface Inspections – Many of the manholes in the study area were observed from the surface during a rain event. The results of the inspection are summarized below by Basin number. The manholes were rated as P-1, P-2 or P-3 during the inspection.

P-1 Manholes are located in swales or are in low areas receiving concentrated flow and are a substantial source of inflow.

P-2 Manholes are subject to sheet flow and are a source of inflow from surface water running across the lids.

P-3 Manholes are typically elevated lids and not subject to Inflow.

The following pictures illustrate P-1 manholes that are sources of Inflow during rain events. Refer to the attached Base Map to reference the locations of the Basins identified.

Surface runoff flowing into manhole.

Close-up view of surface runoff entering manhole cover through the frame and pick hole.

Surface runoff flowing over and into manhole lid.

Basin 1 – The majority of the manholes in this basin are two hole, P-2 lids with some P-1 lids and two P-3 lids. *The manhole lids in this Basin are a source of inflow.*

Basin 2 – The majority of the lids in this basin were not inspected. The lids along Railroad Avenue were inspected and generally the lids are two hole P-1 and P-2 lids due to the fact that they are located next to the curb. *The manhole lids that were inspected in this Basin are a source of inflow.*

Basin 3 – A portion of the lids were inspected in this basin. *The lids inspected are generally two hole, P-2 covers that are a source of some inflow.*

Basin 4 – The majority of the lids in this basin were inspected. The lids are generally P-2 lids; however, there are P-1 covers at the intersection of Water Street and Broadway. *The lids in this Basin are a source of inflow.*

Basin 5 – The majority of the lids were inspected in this basin. The covers are generally two hole, P-2 lids. It should be noted the new manhole covers in Providence Farms are also two hole, P-2 lids and a source of inflow. *The manhole lids in this Basin contribute to inflow.*

Basin 6 – The majority of the manhole lids in this Basin were inspected. The covers are generally, two hole P-2 lids with a few P-3 lids on Route 213 in front of the Business Park and the Food Lion. *The manhole lids in this basin are a source of inflow.*

Basin 7 – The majority of the lids in this Basin were inspected. There is a mix of two hole and older four hole lids. The ratings include P-1 and P-2 lids. *The manhole covers in this basin represent a significant source of inflow.*

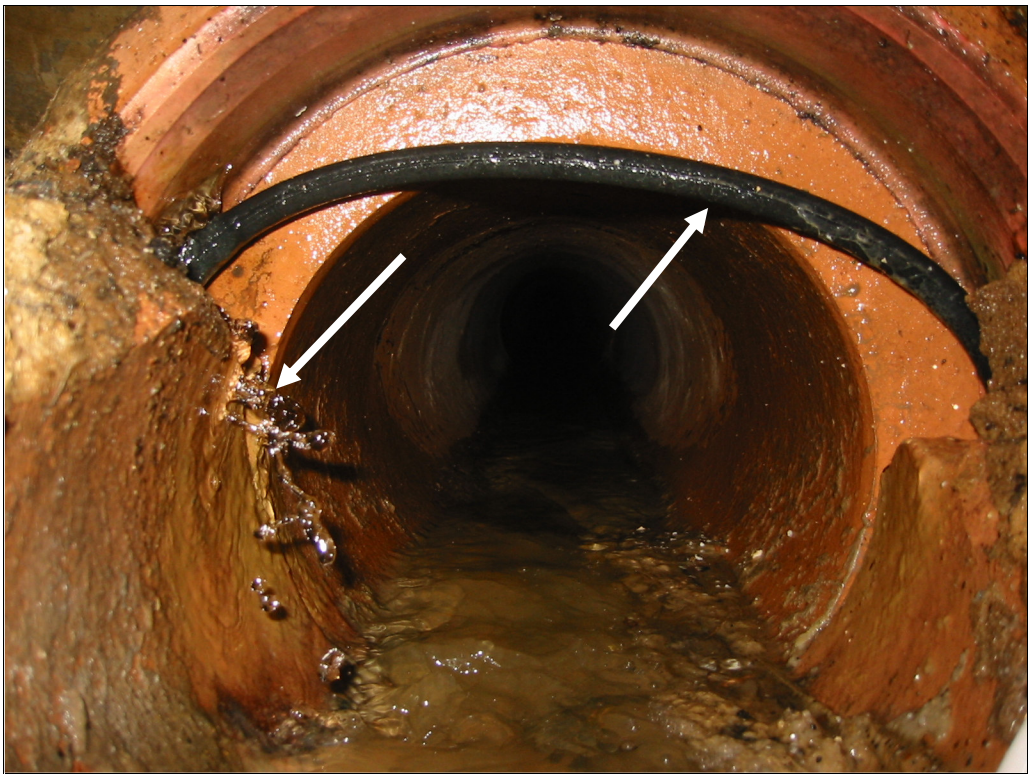
b. Other Observations Related To Manhole Cov+ers Include:

1) Manhole lids North of Bridge St. on Corsica St could not be located and may be significant source of inflow.
2) Manhole 609 could not be located. It should be located because there is standing water in the area during a rain event.
3) The lid is thin and easily displaced on MH 102
4) There is a cracked lid on MH 103

c. Interior Manhole Observations - The inspection included the removal of selected manhole covers to obtain a quick indication of the collection system condition. Several manholes were opened. Fourteen of these manholes were entered to perform the flow monitoring as well. The following are URS' observations relating to manholes:

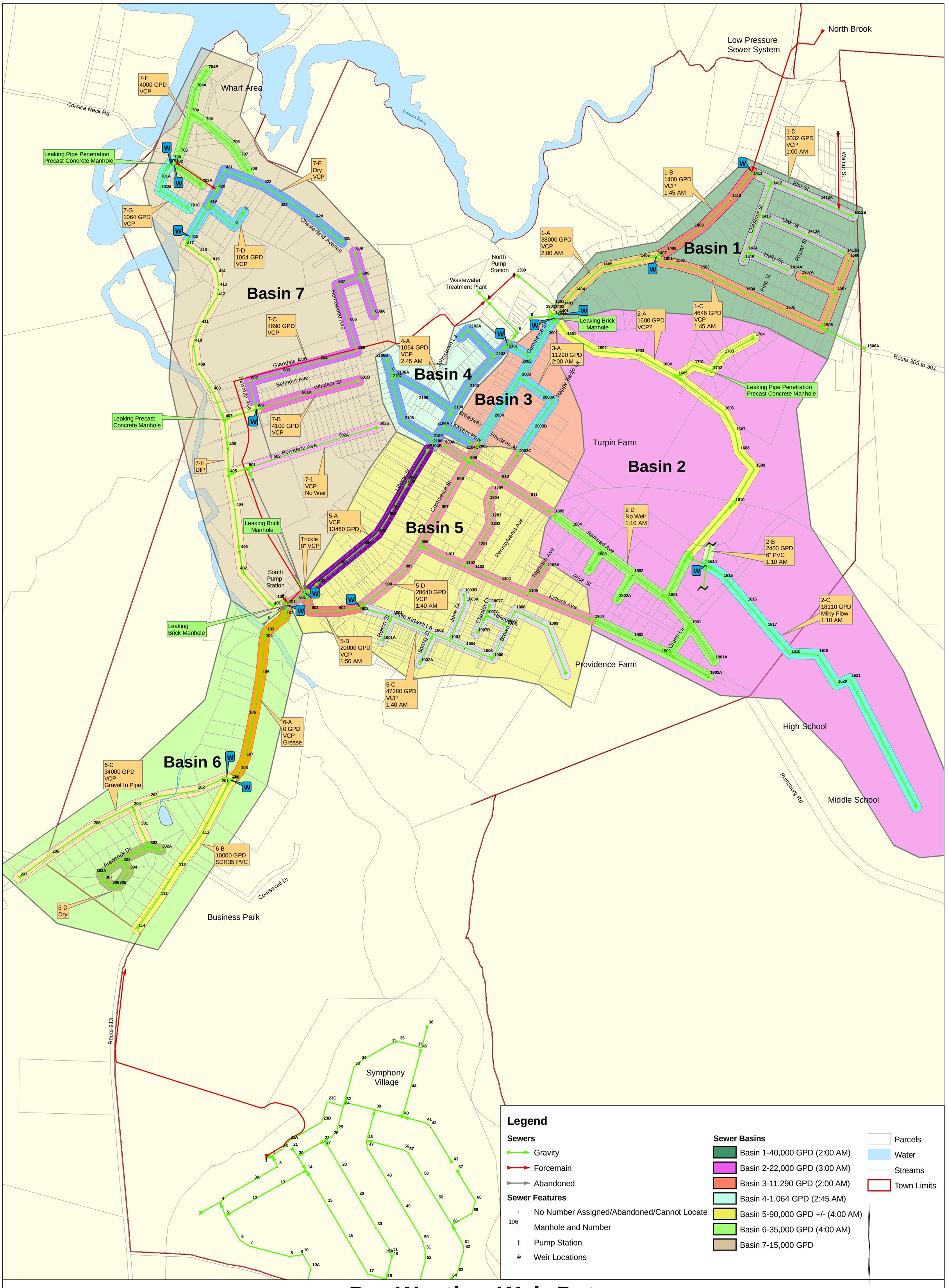
1) The majority of the manholes URS entered for flow monitoring were constructed of brick, however, there were also manholes constructed of precast concrete. Approximately 40% of the manholes entered by URS were actively leaking and most exhibited signs (stains) of infiltration. Many brick manholes were leaking at pipe penetrations and through the brick. Many precast concrete manholes were leaking at pipe penetrations and at the precast concrete joints. Manholes that were observed to be leaking are shown on the attached dry weather weir testing map. The following photos are examples of leaking structures.

Leaking pipe penetrations in manhole. Rust colored deposits below pipes are mineral deposits indicative of groundwater. The pipes are only 2-4 feet below grade, indicating a shallow water table.



Leak from a poor seal between a pipe and manhole channel. The black gasket indicates relatively newer clay pipe.

Pipe leaking groundwater into MH 102. Rust colored deposits below pipe are mineral deposits indicative of groundwater. Possibly an abandoned connection.



Dry Weather Weir Data

TOWN OF CENTREVILLE I & I Study (Phase 1)

SOURCE: MdProperty View, Maryland Department of Planning. 1999.

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Date: April 21, 2005

File Name: R:MD_Centreville\20712690\GIS_job\Mapping\dryweir033005.mxd

0 400 800
Feet
1 inch equals 400 feet